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SUN IGNITION SENSITIVITY OF BASE GRAIN

U. S. NAVAL PROPELLANT PLANT INDIAN HEAD, MARYLAND

RESEARCH AND DEVELOPMENT DEPARTMENT

Technical Memorandum Report 200

SUN IGNITION SENSITIVITY OF BASE GRAIN

By

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15 February 1963

U. S. NAVAL PROPELLANT PLANT
Indian Head, Maryland

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Captain, USNavy
Commanding Officer

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Technical Director

FOREWORD

Work reported herein was performed at the request of the Naval Propellant Plant Production Department. Data are as of 30 November 1961 and are recorded in Laboratory Notebook pages 50185 through 50230.

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ABSTRACT

Ignition of casting powder exposed to the sun in yellow (aluminum-foil-lined) "Leverpaks" occurs when the casting powder is heated to its autoignition temperature through the focusing of the sun's rays by the foil-lined walls. The minimum height of exposed wall of a yellow Leverpak necessary to focus the sun's rays on the powder and produce ignition is 6 inches. Exposure to the sun of casting powder in blue (paper-lined) "Leverpaks" does not focus the sun on the powder. Single-base casting powder is less sensitive to ignition in this manner than double-base or modified double-base casting powder; however, single-base powders are still sensitive.

INTRODUCTION

On 12 June 1961, a fire which occurred at the Naval Propellant Plant consumed a total of 1500 pounds of ABL-705 (AHH propellant) double-base casting powder. The casting powder was being given its final weighing into shipping containers, yellow (aluminum-foil-lined) "Leverpaks,"[1] when the fire occurred. The two possible causes of the fire, listed in the report on the incident,[(1)] were an electrical short-circuit and ignition of the casting powder from exposure to sun. A fused Condulet cover found on the 400-v line to the weighing room supported the short-circuit theory. However, this cover was 8 feet from the point of origin of the fire and faced the opposite direction. The second possible cause of the fire, ignition of the casting powder by focusing of the sun's rays, was proposed on the basis of a report from Radford Arsenal where this phenomenon had been noted with single-base OIO casting powder.[(2,3)]

During the following 2 months, two tests were run by the Production Department to confirm the ignitibility of double-base casting powder upon exposure to the sun. In the first test the exposure time needed for ignition was not recorded; in the second test ignition occurred after 5 to 7 minutes of exposure (Appendix A). On the basis of these results, a detailed investigation was conducted, both in the laboratory and in the field, in an attempt to determine the conditions under which ignition in the sun would occur.

DISCUSSION

Laboratory Tests:

Initial laboratory tests were conducted on samples of modified double-base casting powder (2056-D). These samples were exposed to various types of light, i.e., sunlight, ultraviolet light, and infrared light. Results are given in Table I. No ignition was experienced for either of the samples exposed to ultraviolet light or the casting-powder sample exposed to the sun, indicating that there was no exothermic reaction catalyzed by ultraviolet radiation. Five out of the first six samples exposed to infrared light

[1] Leverpaks are casting-powder shipping containers 15-1/2 inches in diameter and 26-1/2 inches high and are manufactured by Continental Can Company, Incorporated (Specification Number M 2155-37-K-A). Ten-ply fiber walls, permanently attached to the laminated metal bottom, are approximately one-fourth-inch thick. The metal cover is secured to the Leverpak by a lever-actuated clamp.

Yellow Leverpaks receive their name from the yellow paint covering the outer fiber surface of the drum. An aluminum foil liner covers the fiber side walls and laminated bottom of the drum. Blue Leverpaks outer walls are color-coded with a blue paint; they have no lining over the inner walls and bottom.

Table I

EFFECT OF SUNLIGHT, ULTRAVIOLET LIGHT AND INFRARED LIGHT ON IGNITION SENSITIVITY OF 2056-D CASTING POWDER

Date	Test no.	Type of container	Time	Powder weight (g)	Time of exposure (min)	Shaded air temp (°F)	Distance of light source (in.)	Powder temp (°F)	Results	Remarks
					Sunlight					
8-18-61	2	coffee can	1448	2	60	-	-	-	No ignition	-
					Ultraviolet Light					
8-18-61	1	coffee can	1448	2	60	-	-	-	No ignition	-
8-25-61	7	flat dish	1408	2	75	77	1	-	No ignition	-
					Infrared Light					
8-21-61	3	flat dish	-	0.2	68	-	1	-	No ignition	-
8-24-61	4	flat dish	1415	1.7	0.92	-	0.875	240[1]	Flashed	-
8-24-61	5	flat dish	1440	1.5	28	-	2.5	231[1]	Flashed	-
8-24-61	6	flat dish	1546	1.3	13	-	2.5	211[1]	Flashed	Powder began smoking in 2 min.
8-25-61	8	flat dish[2]	1530	-	0.5	-	-	-	Flashed	-
8-25-61	9	flat dish[2]	1535	-	1.5	-	-	-	Flashed	-

See footnotes at end of Table.

Table I (Cont'd)

Date	Test no.	Type of container	Time	Powder weight (g)	Time of exposure (min.)	Shaded air temp (°F)	Distance of light source (in.)	Powder temp (°F)	Results	Remarks
10-6-61	47	Sample pan (2-in.)	-	2	11.5	92	2.5	301	Ignited	-
10-6-61	48	Sample pan (2-in.)	1505	2	50	90	2.5	225-235	No ignition	Lamp was cloudy from previous test.
10-9-61	49	Sample pan (2-in.)	0853	2	9.3	90	2.5	290	Ignited	Lamp washed prior to test.
10-9-61	50	Sample pan (2-in.)	0920	2	175	84	4	215-225	No ignition	-
10-9-61	51	Sample pan (2-in.)	1411	2	13	84	3.250	260	Ignited	25 min. at 225° + 35 min. at 260° - 290° + 20 min. at 290° - 300° F.
10-9-61	52	Sample pan (2-in.)	1445	2	56	88	2.5	-	Ignited	3-in. cardboard tube placed around sample pan.

[1]Temperature not accurate, pyrometer faulty.
[2]Light funneled for concentration.

flashed. The powder ignition temperatures recorded in these last tests were well below the expected ignition temperature of 290° F. A check of the instrumentation showed that the pyrometer was faulty, and in addition, the method of temperature measurement allowed for some heat loss; therefore, the actual temperature of the powder was probably closer to 290° F than was indicated.

Field Tests:

Samples Greater Than One Pound: Nineteen field tests were conducted at the Explosive Ordnance Disposal Facility on samples of modified double-base casting powder (2056-D). Fourteen tests were conducted on samples in yellow (aluminum-foil-lined) Leverpaks and five were conducted on samples in blue (paper-lined) Leverpaks. All containers were tilted at a 60° angle leaving the upper half of the drum empty so that the rays of the sun would reflect off the sides of the container and focus on the powder (Figure 1). The manner in which the drum was tilted focused the sun in the upper middle of the Leverpak early in the morning. As the sun rose the focal point moved down and passed over the surface of the powder.

Each set of tests was divided into two groups—those which were begun before 1300 (1200 EST) and those begun after 1300. Results of these tests are given in Tables II and III. Of the seven samples of 2056-D casting powder tested before 1300, five samples flashed. The other two tests were stopped by rain. Only one of the seven samples tested after 1300 flashed, and that was the one tested the earliest (1350). None of the five samples tested in the blue (paper-lined) Leverpaks ignited, regardless of time of day or length of the test.

A second series of tests were run with samples weighing 8 lb or less, usually 4 lb. In these cases, a bottom-liner for the Leverpak was covered with masking tape, adhesive side up, to hold the powder in place and prevent it from sifting to the shaded part of the container. All eight of the tests run on powder in yellow Leverpaks resulted in ignition. No ignitions were experienced with any sample in blue Leverpaks. Results are shown in Tables IV and V.

Temperature Determinations: Tests 27 and 33 (8 lb of powder each) were each instrumented with 6-point thermocouple grids. The location of the thermocouple points and the recorded temperatures are shown in Figures 2 and 3. Figure 2 (Test 27) shows that the maximum temperature was found around Tip No. 4. At this point (after 65 minutes) the temperature went off scale (150° F). No ignition resulted, however, since there was no powder covering this part of the bottom of the Leverpak. In Test 33, the thermocouple grids were rearranged and the masking tape was used to hold the powder in place. Here, the recorded hot spot occurred around Tip No. 2. After 68 minutes the powder flashed.

A second series of temperature measurements were made with Tempil Sticks which are crayons with known melting points. Chips from these crayons were placed on a bottom liner and the liner exposed to the sun in a yellow (aluminum-foil-lined)

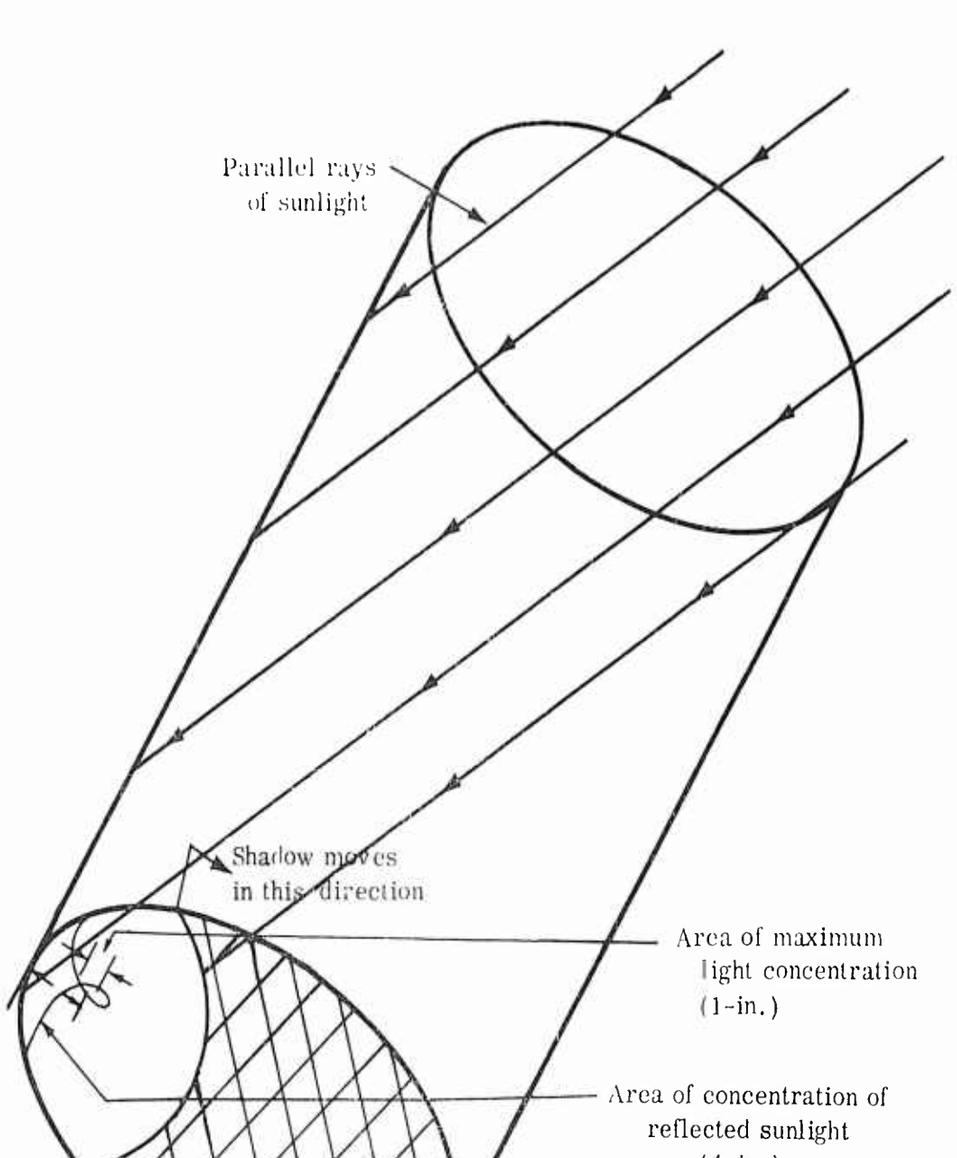

FIGURE 1. VIEW OF INCLINED LEVERPAK SHOWING SUN-EXPOSED AREAS AND SHADE

Table II

EFFECT OF SUN EXPOSURE ON IGNITION SENSITIVITY OF 2056-D CASTING POWDER STORED IN YELLOW LEVERPAKS

[Samples ≥8 lb]

Date	Test no.	Time test began (EDT)	Weight of powder (lb)	Time of exposure (min)	Shaded air temp (°F)	Powder temp (°F)	Relative humidity (%)	Results
9-12-61	17	1047	8	118	83-87	-	72-68	Flashed
9-22-61	23	1141	8	51	79	-	70	Flashed
9-22-61	24	1147	8	57	79	-	70	Flashed
9-14-61	21	1215	8	60	82	-	86	No Ignition[1]
9-14-61	22	1215	8	60	82	-	86	No Ignition[1]
9-22-61	25	1223	8	93	79	-	70	Flashed
9-22-61	26	1228	8	98	79	-	70	Flashed
9-12-61	18	1350	8	25	90-94	-	62	Flashed
9-25-61	29	1353	8	108	91-94	-	55-60	No Ignition
9-25-61	28	1354	8[2]	109	91-94	-	55-60	No Ignition
9-25-61	27	1355	8	108	91-94	-	55-60	No Ignition
9-5-61	10	1358	8	37	-	-	-	No Ignition
9-5-61	11	1455	20	38	-	-	-	No Ignition
9-6-61	12	1455	8	180	-	110-120	-	No Ignition

[1] Test concluded on account of rain.

[2] Sample contained 6 lb of caked powder and 2 lb of uncaked powder.

Table III

EFFECT OF SUN EXPOSURE ON IGNITION SENSITIVITY OF 2056-D CASTING POWDER STORED IN BLUE LEVERPAKS

[Samples ≥8 lb]

Date	Test no.	Time test began (EDT)	Weight of powder (lb)	Time of exposure (min)	Shaded air temp (°F)	Relative humidity (%)	Results
9-13-61	19	1122	8	188	88	70-80	No Ignition
9-13-61	20	1122	8	188	88	70-80	No Ignition
9-25-61	31	1350	8	115	91-94	55-60	No Ignition
9-25-61	30	1351	8	114	91-94	55-50	No Ignition
9-6-61	15	1455	8	270	-	-	No Ignition

Table IV

EFFECT OF SUN EXPOSURE ON IGNITION SENSITIVITY OF 2056-D CASTING POWDER STORED IN YELLOW LEVERPAKS WITH BOTTOM LINER

[Samples ≤8 lb]

Date	Test no.	Time test began (EDT)	Weight of powder (lb)	Time of exposure (min)	Shaded air temp (°F)	Relative humidity (%)	Results
9-28-61	39	1057	4	48	73	62-64	Ignited
9-28-61	40	1057	4	68	74	62-64	Ignited
9-28-61	41	1057	4	1.5	70	63-66	Ignited
9-26-61	32	1234	4	2	77	59	Ignited
9-26-61	36	1327	4	116(58)[1]	75	64	Ignited
9-26-61	37	1327	4	123(65)[1]	75	62-64	Ignited
9-26-61	38	1327	4	10	75	62-64	Ignited
9-26-61	33	1333	8	68	79	59	Ignited

[1]Cloud cover until 1515. Numbers in parentheses indicate time of actual exposure to sun.

Table V

EFFECT OF SUN EXPOSURE ON IGNITION SENSITIVITY OF 2056-D CASTING POWDER STORED IN BLUE LEVERPAKS WITH BOTTOM LINER

[Samples ≤8 lb]

Date	Test no.	Time test began (EDT)	Weight of powder (lb)	Time of exposure (min)	Shaded air temp (°F)	Relative humidity (%)	Results
9-26-61	34	1221	4	84	82	58	No reation
9-26-61	35	1221	4	84	82	58	No reation

Leverpak to confirm that a hot spot was being developed on the Leverpak bottom and to indicate its location. Preliminary tests located the focal point as shown in Figure 1 and showed the maximum temperature to be about 275° F. A similar test was run with a blue (paper-lined) Leverpak inclined to the sun. After 1 hour, the 125° F chips had melted, but the 150° F chips showed no signs of melting.

A thermocouple was then placed at the expected focal point in such a way that it could be located visually when a bottom liner was placed in the Leverpak. After

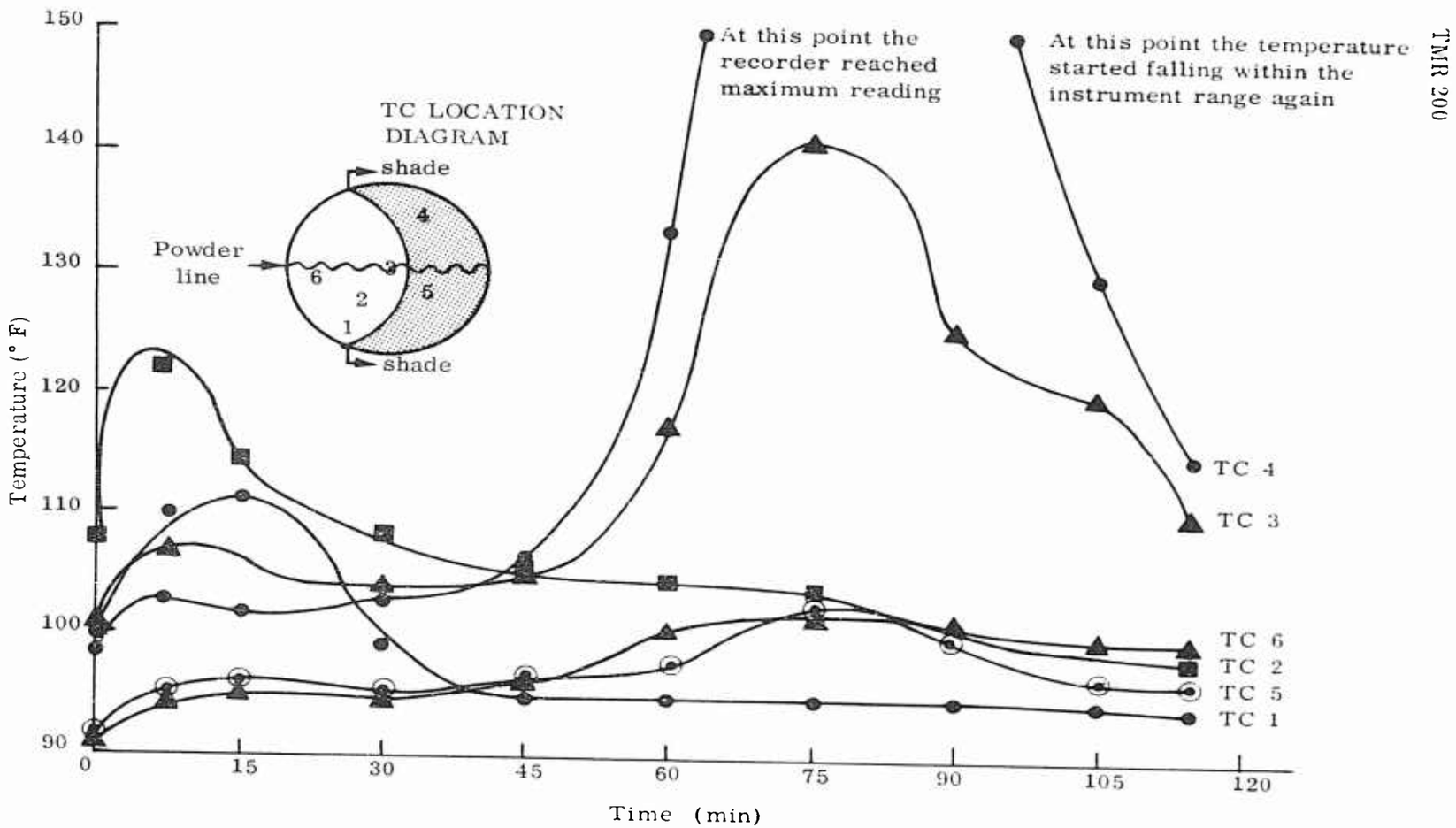

FIGURE 2. EFFECT OF SUN EXPOSURE ON TEMPERATURE IN FOIL-LINED LEVERPAK WITHOUT BOTTOM LINER

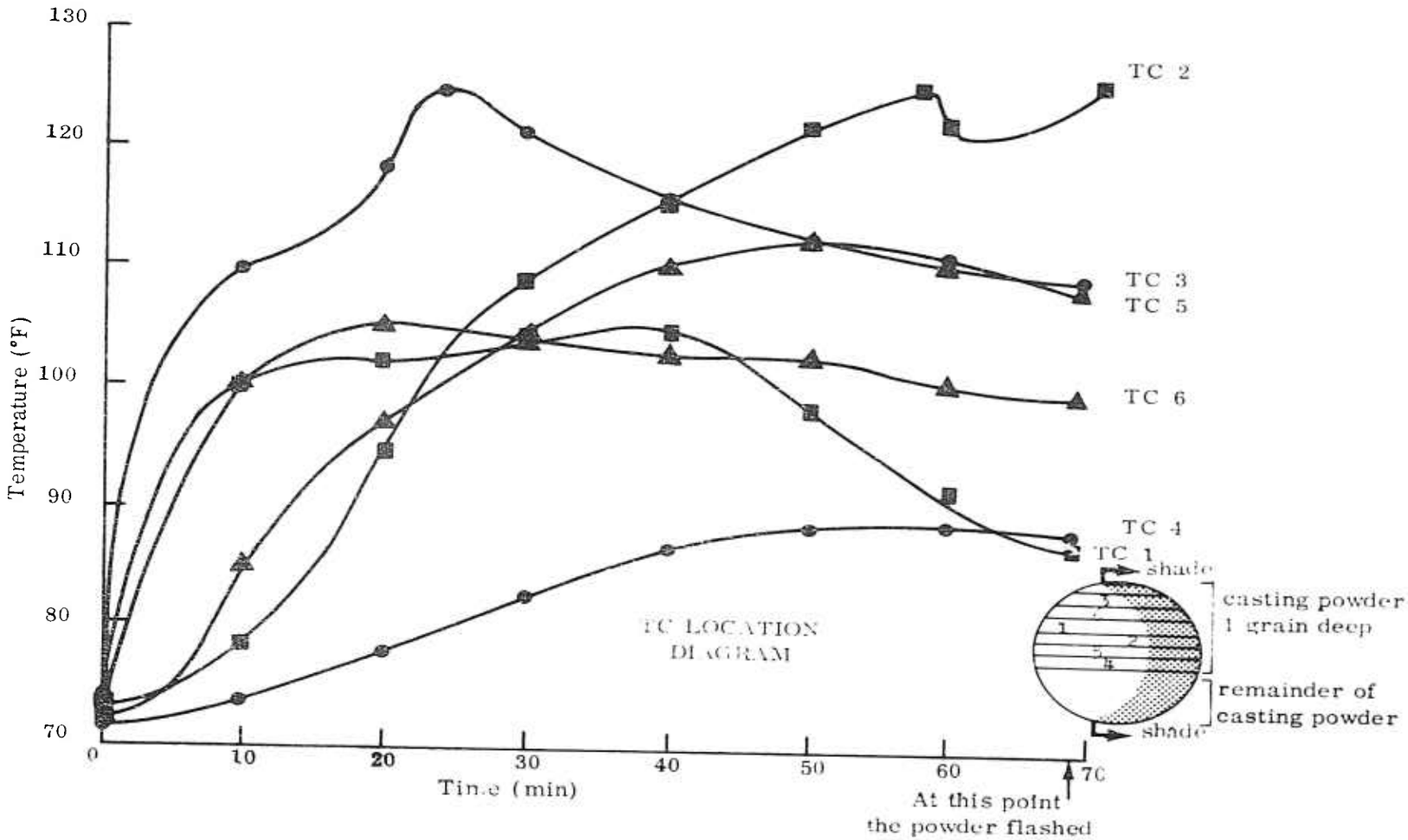

FIGURE 3. EFFECT OF SUN EXPOSURE ON TEMPERATURE IN FOIL-LINED LEVERPAK WITH BOTTOM LINER

12 minutes of exposure on a clear day with a shaded air temperature of 82° F, the maximum temperature recorded at this focal point was 312° F. The maximum intensity occurred when only one-third of the bottom area was exposed to the sun.

Samples Less Than One Pound of Powder: A third series of field tests was then conducted in which ten to fifteen 0.050-inch diameter × 0.050-inch grains of 2056-D were exposed to the focused sunlight. The detailed test procedure is given in Appendix B. The grains were placed in a three-fourth-inch circle near the expected focal point on a bottom liner in a yellow (alluminum-foil-lined) Leverpak. In this manner, the focal point should take 5-10 minutes to travel across the powder circle. Similar tests were conducted on ABL 705 (AHH) double-base and ABL 77 (OIY) single-base casting powder. Results are given in Table VI. All three samples of 2056-D modified double-base powder ignited—one at 325°-350° F, the other two at unknown temperatures. Of the four tests run on ABL 705 (AHH) double-base powder, two ignited at temperatures around 300°-335° F and in the remaining two tests the grains were scorched. Eight tests were run on ABL 77 (OIY) single-base powder; in one case some of the grains were scorched, and, in another, three grains ignited without propagating the ignition to the balance of the grains.

Cast Propellant Flakes: Four tests were run on 3/16- × 3/16- × 1/16-inch flakes of cast DDP-70 propellant. Two samples ignited at 296° and 275° F. Results of all four tests are shown in Table VII.

The temperature recorded at the focal point in the Leverpaks was near or above the autoignition temperature of the propellant or base grain in each of the tests previously discussed in which ignition took place. These data show that the cause of the ignition was the temperature generated at the focal point rather than the sun's rays catalyzing any chemical reaction.

Effect of Height of Powder in Drum: An experiment was designed to determine the effect of exposed wall area on the focal point intensity (Figure 4). This experiment simulated the intensity of the focal point on the powder with respect to varied depths of exposed powder in the yellow Leverpak. The results of this test (Figure 4) show that the intensity of the focal point in a vertical drum stays approximately the same as it is on the bottom until a level 9 inches from the open end of the Leverpak has been reached. If the level of powder in a Leverpak was further than 6 inches away from the top of the container there would be a definite possibility of ignition under strong slanting sunlight. It was also found during these tests that wind blowing into the Leverpak may have a cooling effect of as much as 60° F. This effect becomes increasingly noticeable as the height of the powder layer increases.

Effect of Room Illumination: With the knowledge that a focal point is formed by the sunlight, an explosion-proof lamp was used in an attempt to produce a focal point. No hot spot was formed by light from this lamp placed a distance of 1 foot from the

Table VI

EFFECT OF SUN'S FOCAL POINT ON IGNITION SENSITIVITY OF CASTING POWDER IN YELLOW LEVERPAKS

[15-Grain samples]

Date	Test no.	Time test began (EDT)	Time of exposure (min)	Shaded air temp (°F)	Ignition temp (°F)
2056-D Modified Double-Base Casting Powder					
10-16-61	62	1312	8.5	67	325-350
10-10-61	55	1518	9	80	1
10-10-61	56	1533	27	80	-
10-11-61	56[2]	1052	26	77	2
705 (AHH) Double-Base Casting Powder					
10-13-61	60	1305	70	82	3
10-13-61	61	1323	52	82	4
10-16-61	63	1333	5	67	300
10-16-61	64	1344	43	67	335
77 (OIY) Single-Base Casting Powder					
10-11-61	57	1338	142	84	-
10-12-61	57[2]	1207	53	79	2
10-13-61	58	1237	98	82	3
10-13-61	59	1250	85	82	No Ignition
10-19-61	66[2]	1323	4	80	No Ignition
10-19-61	67	1346	64	80	No Ignition
10-19-61	68	1349	61	80	No Ignition
10-19-61	69	1352	58	80	5
10-16-61	65[2]	1435	9	67	No Ignition

[1] Ignited - temperature not recorded.

[2] Test conducted in two parts, two different days. After second day's exposure two to three individual grains had ignited.

[3] Grains scorched and charred - no ignition.

[4] Part of grains were scorched.

[5] Grains ignited.

Table VII

EFFECT OF SUN'S FOCAL POINT ON IGNITION SENSITIVITY OF CAST PROPELLANT DDP-70 IN YELLOW LEVERPAKS

[10-15 Flakes 3/16 x 3/16 x 1/16 Inch]

Date	Test no.	Time test began (EST)	Time of exposure (min)	Shaded air temp (°F)	Powder temp (°F)	Ignition temp (°F)
11-7-61	70	1117	138	62	296	296
11-7-61	71	1135	110	62	275	275
11-7-61	72	1135	235	62	-	no ignition
11-7-61	73	1356	94	62	-	no ignition

Leverpak top. The lamp housing itself was also checked to determine the possibility of ignition if casting powder should come in contact with the lamp housing. Temperatures on this lamp are given in Table VIII. None of these temperatures exceeded 210° F which is 80° F below the autoignition temperature of most casting powder. Therefore, the heat from the lamp should not cause ignition.

Table VIII

TEMPERATURES[1] GENERATED BY A 300-WATT CROUSE-HINDS EXPLOSION-PROOF LAMP

Time of exposure (min)	Portion of lamp tested (°F)			
	Glass lens	Aluminum lens guard	Aluminum housing	
			Front	Side
0	74	74	74	74
105	189	143	150	146
165	206	153	160	155
290	203	156	160	152
410	206	155	160	155

1 Temperatures recorded by thermocouples embedded in a thermally conductive cement wall.

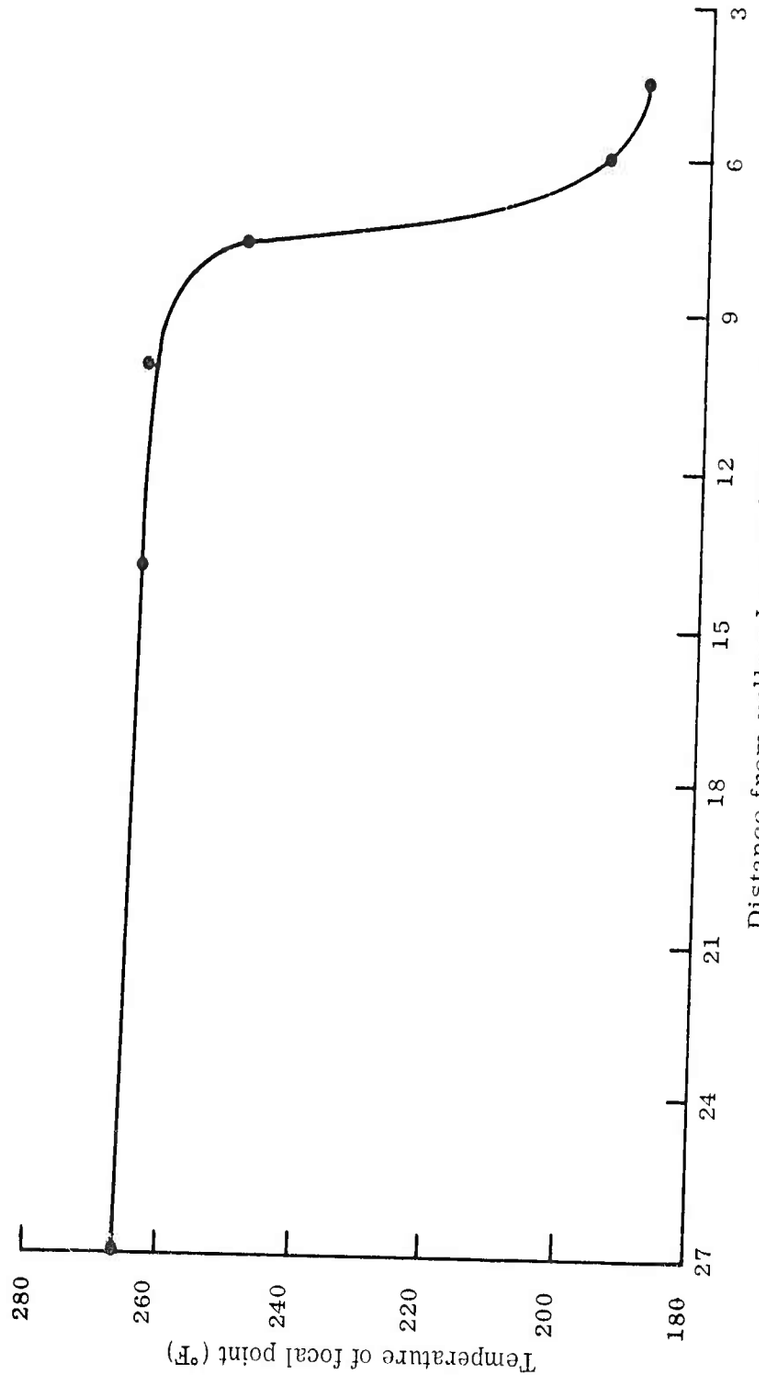

FIGURE 4. EFFECT OF EXPOSED WALL AREA ON FOCAL POINT INTENSITY

CONCLUSIONS

(1) The ignition of casting powder in open yellow Leverpaks is caused by localized heating at a focal point formed by the container's aluminum-foil-liner.

(2) The probability of ignition of casting powder left in open yellow Leverpaks increases with increased sun temperature and may occur on clear days with shaded air temperatures above 65° F.

(3) Focusing did not occur in the blue (paper-lined) Leverpaks; however, direct exposure of casting powder to sunlight in any container should be avoided.

(4) Single-base casting powder seems to be less sensitive to sun exposure in yellow Leverpaks than modified double-base casting powder, double-base casting powder, or cast double-base (DDP-70) propellant.

(5) Ignition of casting powder in yellow Leverpaks can occur in as little as 2-5 minutes after initial exposure.

(6) Light created by a 300-watt Crouse-Hinds explosion-proof lamp cannot be focused by the aluminum-foil walls of the yellow Leverpak and therefore should not create an ignition hazard. This same lamp will not generate enough heat to cause ignition of casting-powder should direct contact occur.

REFERENCES

(1) Naval Propellant Plant memorandum on, "Fire at Remote Packing," Building 313 P2X: JTO: pbh, 16 June 1961.

(2) Radford Arsenal, Final Report, "Quality Assurance Investigation 1136." 28 July 1961. UNCLASSIFIED

(3) Communication from E. H. Carroll, Technical Director, Radford Arsenal to J. E. Settes, Technical Assistant, Chemical Propulsion Division, Explosives Department, Hercules Powder Co., on "Accidental Ignition of ABL 2261 and ABL 2478 Casting Powders," dated 1 June 1961.

Appendix A

IGNITIBILITY TESTS OF CASTING POWDER EXPOSED TO SUNLIGHT

P2/CWB:gwf
12 September 1961

COPY

MEMORANDUM

From: P
To: K

Subj: Ignitibility Tests of Casting Powder exposed to sunlight

1. The Production Department of the Naval Propellant Plant recently conducted several exposure tests to determine sensitivity of casting powder to ignition by sunlight, particularly in aluminum-lined Leverpak containers. The results indicate that ignition of either high-impulse or multi-base casting powder may occur within 10 minutes of exposure to sunlight. Aluminum-lined containers may reduce ignition time to less than 5 minutes.

2. On 14 July 1961, at 1200 hours, (air temperature 104° F) 4 lb of casting powder was placed in each of four open Leverpak containers exposed to sunlight. A powder operator stationed on watch did not observe any flames but after dark the containers were examined with the following results:

Leverpak Type	ADL 2056-D High Impulse	ABL 705 Multi Base
Aluminum lined (yellow)	ignited	no ignition
Fiberboard lined (blue)	ignited	ignited

3. A second test was conducted 10 August 1961 (air temperature 105° F). Containers were spaced about 10 feet apart to accommodate thermocouple leads to a continuous recorder. Again 4 pounds of propellant was placed in each container. Results follow:

Container	Time (minutes) to ignition ABL 2056-D	ABL 705
Leverpak (aluminum-lined)	less than 5	7
Leverpak (fibre-lined)	7	7
"13" metal scrap can	7	not tested

Ignition times considerably shorter than anticipated resulted in "rough" time measurement and the recorder was of no value. Ignition of the four containers almost simultaneously suggests the possibility of hot particles causing ignition. None of the containers in either tests showed any external evidence of charring.

4. Action taken:

(a) The existing contract for aluminum-lined Leverpaks (8,000 ordered, 5,000 delivered to date) was suspended. Design was changed to provide aluminum lining only on container bottom to retain conductivity.

(b) The work on better definition of this problem has been referred to the Research and Development Department of NPP to conduct tests in such areas as exposure of propellant at the burning ground during preparations for burning, and exposure of cast solid propellant grains to sunlight.

(c) All aluminum-lined containers now "in the system" will be disposed of as they are emptied.

(d) Operating personnel have been advised of the necessity for avoiding exposure of propellant to sunlight.

A. G. MAYER

cc: PR (w/encl.)
P1
P2
P3 (w/encl.)
P4
P5
P6
P7
P8
(w/encl.)
(w/encl.)
Ro-t
(w/encl.)

COPY

Appendix B

PROCEDURE FOR SUN IGNITION TESTS

This Experimental Procedure outlines the method of conducting sun-ignition tests on casting powder. Small samples (10-15 pellets, approximately 0.050- × 0.050-inch) of a casting powder formulation are placed with a thermocouple on a bottom liner in a yellow Leverpak. This Leverpak will then be exposed to the sun, with the rays of the sun focused on the small amount of casting powder.

Because this work is experimental in nature, it may be necessary to deviate slightly from the procedure as stated below. However, standard safety precautions for the handling of casting powder will be observed at all times.

(1) The following will be in the testing area before the casting powder to be tested is brought to the area: yellow Leverpaks, cardboard or asbestos liners, masking tape, pyrometer, pyrometer leads, thermocouples, thermometer, and humidity meter.

(2) Upon a circle of asbestos or cardboard sheeting, slightly smaller in diameter than the Leverpak, will be placed, from the center to the edge, a 2-inch wide strip of masking tape. This tape will be placed in such a manner that its adhesive side will be facing outward over the area to be covered.

(3) Ten to fifteen casting powder granules totaling less than 0.1 gram in weight will be placed on the sheeting in a space approximately 3/4-inch in diameter, located so that the center of this area is 3-1/2 to 4 inches from the Leverpak wall when the sheeting is inserted in the Leverpak.

(4) A thermocouple will be placed on the sheeting in such a position that it will record temperatures in the area occupied by the casting powder. This thermocouple will be taped in the above position, keeping the junction against the liner.

(5) The sheeting, or bottom liner, will then be placed in the Leverpak with the powder side upwards. The Leverpak lid will then be replaced on the Leverpak.

(6) Place the Leverpak a minimum distance of 10-25 feet from the control area.

(7) Connect the thermocouple to the pyrometer leads.

(8) Uncover and expose the Leverpak to the sun in such a manner that the focal point of the reflected light is centered on the circle of casting powder. The flash hazard is not great as long as the operator remains at least 2 feet from the base grain because the flame is only 4 to 6 inches high.

(9) Records will be kept of thermocouple temperatures, sun-exposure time for the Leverpak, shade temperature, relative humidity, and sky conditions.

(10) The mirrored light will be refocused on the circle of casting powder every 10 minutes.

(11) After ignition of the base grain is noted by the pyrometer, the Leverpak lid will be tightly replaced on the Leverpak to snuff out any fire that might start on the liner inside the Leverpak. The flame created upon ignition of the casting powder itself immediately dies out.

(12) Simultaneous runs of this experiment may be desirable. These additional Leverpaks should be placed in a line perpendicular to the direction of the thermocouple leads to the first Leverpak and spaced at least 6 feet apart.

(13) There will be a maximum limit of 20 pounds of explosive samples in the area kept in a pit barricade.

This report has been distributed
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Mailing List of the Chemical Propulsion
Information Agency.

Naval Propellant Plant, Indian Head, Maryland (TMR 200) SUN IGNITION SENSITIVITY OF BASE GRAIN (U) by G. C. Heilig and C. B. Dale. 24 pp. 15 February 1963. UNCLASSIFIED Ignition of casting powder exposed to the sun in yellow (aluminum-foil-lined) "Leverpaks" occurs when the casting powder is heated to its autoignition temperature through the focusing of the sun's rays on the foil-lined walls.	UNCLASSIFIED 1. Casting Powder - Ignition 2. Leverpaks 3. Sun Ignition I. Heilig, G. C. II. Dale, C. B. UNCLASSIFIED	Naval Propellant Plant, Indian Head, Maryland (TMR 200) SUN IGNITION SENSITIVITY OF BASE GRAIN (U) by G. C. Heilig and C. B. Dale. 24 pp. 15 February 1963. UNCLASSIFIED Ignition of casting powder exposed to the sun in yellow (aluminum-foil-lined) "Leverpaks" occurs when the casting powder is heated to its autoignition temperature through the focusing of the sun's rays on the foil-lined walls.	UNCLASSIFIED 1. Casting Powder - Ignition 2. Leverpaks 3. Sun Ignition I. Heilig, G. C. II. Dale, C. B. UNCLASSIFIED
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